The Great Lakes Green Chemistry Network: Innovative Collaborations to Restore and Protect the Great Lakes from Toxic Chemicals

2011 State of Lake Michigan
Great Lakes Beach Association
Joint Conference
September 27, 2011
Michigan City, Indiana

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Addressing Great Lakes Challenges
with Green Chemistry Solutions

Crescent Dune
Michigan City, Indiana

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Fox River, Wisconsin

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Indiana Dunes National Lakeshore

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Green Bay, Wisconsin

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Indiana Harbor Canal
East Chicago, IN

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"JOB KILLERS?"

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Some Statistics About Toxics in Lake Michigan

- **10 (> 23%) of 43 Great Lakes Areas of Concern are in Lake Michigan**
- **Over one□ fifth (21%) of total releases in the Great Lakes□ St. Lawrence River basin in 2007 came from the Lake Michigan Basin**
  - **30% of water releases**
  - **16% of air releases†**
- **Primary metals facilities (such as smelters and steel mills) accounted for over half (52%) of water releases, and power plants accounted for 44% of air releases within the Lake Michigan basin.†**

†*Partners in Pollution 2*, Pollution Watch, Toronto, ON, 2010.

The Grand Calumet River Area of Concern

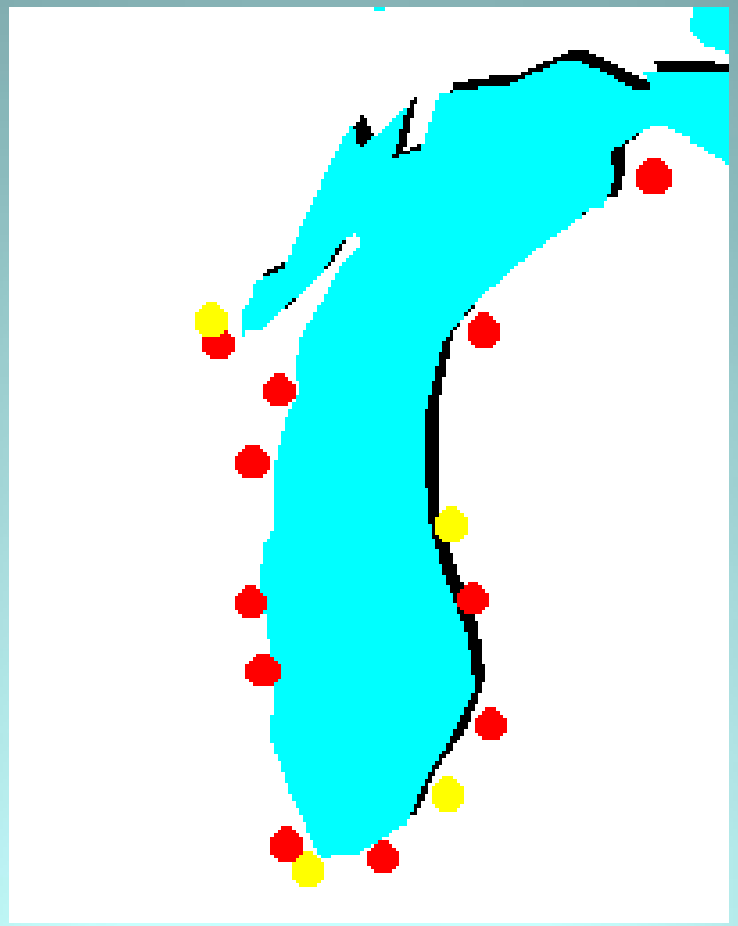
The Grand Calumet River and Indiana Harbor and Canal contain

- **5 to 10 million cubic yards (3.9 to 7.7 million cubic meters) of contaminated sediment up to 20 feet (6 m) deep. These include**
  - **Toxic compounds such as PAHs, PCBs and heavy metals**
  - **Conventional pollutants such as phosphorus, nitrogen, iron, magnesium, volatile solids, oil and grease.**
- **52 CERCLA sites; five of these sites are Superfund sites on the National Priorities List (NPL).**
- **423 RCRA sites**

Atmospheric deposition of toxic substances comes from fossil fuel burning, waste incineration and evaporation. Toxins from these sources include

- **dioxins**
- **PCBs**
- **insecticides**
- **heavy metals.**

Confined Disposal Facilities on Lake Michigan



Miller, Jan, *Confined Disposal Facilities on the Great Lakes, US ACE, 1998*

Milwaukee Confined Disposal Facility

Miller, Jan, *Confined Disposal Facilities on the Great Lakes, US ACE, 1998*

What is GREEN CHEMISTRY?

The Definition of Green Chemistry:

Green chemistry is the **design** of chemical products and processes that *reduce* or *eliminate* the use and generation of hazardous substances based on the **principles of green chemistry**

The 12 Principles of Green Chemistry

1. **Prevention.**
2. **Atom economy.**
3. **Less hazardous chemical synthesis.**
4. **Designing safer chemicals.**
5. **Safer solvents and auxillaries.**
6. **Design for energy efficiency.**
7. **Use of renewable feedstocks.**
8. **Reduce derivatives.**
9. **Catalysis (Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.)**
10. **Design for degradation.**
11. **Real time analysis for pollution prevention.**
12. **Inherently safer chemistry for accident prevention.**

Anastas, P. T.; Warner, J. C.; **Green Chemistry: Theory and Practice**, Oxford University Press: New York, 1998

The 12 Principles of Green Engineering

1. Inherent Rather Than Circumstantial
2. Prevention Instead of Treatment
3. Design for Separation
4. Maximize Efficiency
5. Output-Pulled Versus Input-Pushed
6. Conserve Complexity
7. Durability Rather Than Immortality
8. Meet Need, Minimize Excess
9. Minimize Material Diversity
10. Integrate Material and Energy Flows
11. Design for Commercial "Afterlife"
12. Renewable Rather Than Depleting

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Anastas, P.T., and Zimmerman, J.B., "Design through the Twelve Principles of Green Engineering", Env. Sci. Tech. 2003, 37(5), 94A-101A.

Examples of Green Chemistry and Engineering:

- A potent nonhazardous process for destroying trace pharmaceuticals in water would amount to ***green chemistry and green engineering.*** This is the work in which green chemists are currently engaged at places such as Carnegie Mellon Institute.

- Green chemistry and engineering solutions for cleaning up contaminated sediments, soils, and groundwater are already on the market. These have tremendous potential for addressing legacy contamination alternatives to the current reliance on “dredge and dump”.

THE MISSION OF THE GREAT LAKES GREEN CHEMISTRY NETWORK

is to protect and restore the bi-national Great Lakes ecosystem from the impacts of toxic chemical contamination by facilitating and advocating the adoption of Green Chemistry* in industry practices, academia, and through government policies. We do this through business collaborations, educational outreach to teachers and students, young scientists, dialogue with government regulators, public education and engagement, and promoting green chemistry as a driver of economic development.

* As defined by the **Twelve Principles of Green Chemistry**

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THE GREAT LAKES GREEN CHEMISTRY NETWORK

- **Works to Promote Communication and Collaboration between sectors of interest**
  - **Industry**
  - **Government**
  - **Academia**
  - **NGOs**
  - **Labor**

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The Great Lakes Green Chemistry Network

- **Collaborates on projects which address our mission and goals**
- **Actively participates in chemicals policy discussions**
- **Participates and presents at conferences and meetings**

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The Great Lakes Green Chemistry Network

Works to

- **promote and stimulate research on Great Lakes challenges using the principles of green chemistry and green engineering**
- **offer resources and access to information on green chemistry and green engineering through our website**

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- Monthly free webinars with experts in Green Chemistry and related fields
- Currently collaborating with
  - the Michigan Green Chemistry Clearinghouse
  - the National Pollution Prevention Roundtable
    - Clean Production Action
    - Great Lakes Regional Pollution Prevention Roundtable

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The Great Lakes Green Chemistry Student Network

- Launching officially in 2011
- Use of social networking tools
- Interactive internet educational features
- Student mentoring and outreach program
- Student challenge on Great Lakes issues

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The Great Lakes Green Chemistry Network

Coming in 2012:

- ❑ **Workshops on the Green Screen with Clean Production Action**
- ❑ **Great Lakes Green Chemistry Conference, Chicago, IL**

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The Great Lakes Green Chemistry Network

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